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ABSTRACT

Commonly, tournament directors are responsible for organizing round robin leagues for team sports that have several divisions of play. On occasion, the director may have to operate under certain constraints that limit the number of games that can be played per day and the number of days that can be utilized. After receiving entries in each division, the director must then determine how many leagues can be developed and how many teams can be in each league. Unless the director has access to a computer and a computer program that will solve the problem quickly, the director would benefit from a systematic approach to structuring the round robin leagues. This presentation defines such an approach. (Author)

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A SYSTEMATIC APPROACH TO STRUCTURING ROUND ROBIN LEAGUES

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Commonly, tournament directors are responsible for organizing round robin leagues for team sports that have several divisions of play. On occasion the director may have to operate under certain constraints that limit the number of games that can be played per day and the number of days that can be utilized. After receiving entries in each division, the director must then determine how many leagues can be developed and how many teams can be in each league. Unless the director has access to a computer and a computer program that will solve the problem quickly, the director would benefit from a systematic approach to structuring the round robin leagues. This presentation defines such an approach.

by

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A SYSTEMATIC APPROACH TO STRUCTURING ROUND ROBIN LEAGUES

Commonly, tournament directors are responsible for organizing round robin leagues for team sports that have several divisions of play (for example, Men, Women, Youth). On occasion the director may have to operate under certain constraints that limit the number of games that can be played per day and the number of days that can be utilized. After receiving entries in each division, the director must then determine how many leagues can be developed and how many teams can be in each league. Unless the director has access to a computer and a computer program that will solve the problem quickly, the director would benefit from a systematic approach to structuring the round robin leagues. This presentation defines such an approach.

THE SITUATION: A tournament director is responsible for a basketball program that has three divisions of play. There are two courts available, and they can be used in four time slots per day, resulting in an 8 games/day capability. The program can run for a maximum of 38 days. When the director takes team entries, a certain number is received in each division (N=37, N=24, N=57). The director does not want to schedule a team for play more than once per day, and it is assumed that no postponements are possible. After a champion is determined in each league, a single elimination tournament between champions will determine a division champion in each division.

THE PROBLEM: Given the above situation (N=37, N=24, N=57; 8 gms per day; 38 days available), the director must determine the minimum

number of leagues that can be accommodated in each division, such that leagues throughout all three divisions of play will be approximately the same size. By minimizing the number of leagues, the number of entries per league will be maximized, which in turn maximizes the number of games that can be played by each team. The final solution to the problem will indicate how many leagues are in each division and how many teams are in each league.

THE SOLUTION:

STEP(1): Estimate the number of days it will take for the single elimination playoff between league champions in each division.

(1a): Determine total games available by multiplying games/day (8) times the number of days (38).

$$8 \times 38 = 304 \text{ total games}$$

(1b): Determine the total number of teams in the program.

$$37 + 24 + 57 = 118 \text{ total teams in all divisions}$$

(1c): Approximate league size across all divisions by dividing the number of teams (118) into total games available times two ($304 \times 2 = 608$). For calculation purposes, games are doubled (or the number of teams could be halved) because two teams are occupied for each game, not just one.

608/118 = 5.15

(1d): Approximate the number of leagues that will be formed in each division of play by dividing 5 into each number of entries.

37/5 = 7.4 24/5 = 4.8 57/5 = 11.4

Round off to lower number.

N = 7 N = 4 N = 11

(1e): Determine the number of rounds and games per round for the combined single elimination playoffs across all three divisions.

Rounds	1	2	3	4	
N = 7		3	2	1	
N = 4			2	1	
N = 11	3	4	2	1	
Total games per round	3	7	6	3	
Days to play at 8 gms/day	1	1	1	1	Total 4 days

(1f): CONCLUSION: in all probability, 4 days of available games must be set aside from the outset to accommodate the single elimination playoffs at the end of league play. It would also be prudent to set aside one other day for settling possible league ties. A total of 5 days, i.e., 40 games (5 x 8 gms/day) must be subtracted from the total games available to arrive at the total number of games available for actual league play.

304 - 40 = 264 total games available

STEP(2): Given the number of games available (264), determine the approximate number of games that each team can play by multiplying games available by two (264 x 2 = 528) and dividing by the total number of teams (118).

528/118 = 4.47

STEP(3): Since the number of games per team in a round robin league is N-1, and in this case N-1 = 4.47, the actual number of teams that can be in the league is:

$$N-1 = 4.47$$
$$N = 4.47 + 1$$
$$N = 5.47$$

What this means is that league sizes within each division must be either 5 or 6.

STEP(4): Determine the sizes and number of leagues in division N=37.

(4a): Divide 37 by approximate league size (5).

37/5 = 7 plus 2 teams left over

At this point the result is 7 leagues of 5, plus 2 teams.

Two of the leagues must take on an extra team.

So, the result is 2 leagues of 6, 5 leagues of 5.

(4b): Determine the number of games required to play those round robin leagues. The formula is, N(N-1)/2 = games.

league of 6	league of 5
6(6-1)/2 = 15 gms	5(5-1)/2 = 10 gms
15 gms x 2 lgs = 30 gms	10 gms x 5 lgs = 50 gms

Total League Games = 30 + 50 = 80

STEP(5): Determine the sizes and number of leagues in division N=24.

(5a): Divide 24 by approximate league size (5).

24/5 = 4 plus 4 teams left over.

Add one team to each league to get 4 leagues of 6 teams.

(5b): Determine the number of games required to play those round robin leagues. Formula: N(N-1)/2 = games.

League of 6

6(6-1)/2 = 15 gms

15 gms x 4 lgs = 60 games

STEP(6): Determine how many games are available for play in the third division by adding the games already used in the first two divisions and subtracting from the total available.

80 + 60 = 140 used

264 - 140 = 124 games remaining

STEP(7): Determine the sizes and number of leagues in division N=57.

(7a): Divide 57 by approximate league size (5).

57/5 = 11 plus 2 teams left over

Add one team to each of two leagues to get 2 leagues of 6, and 9 leagues of 5.

(7b): Determine the number of games required to play those round robin leagues. Formula: N(N-1)/2 = games.

League of 6	League of 5
6(6-1)/2 = 15 gms	5(5-1)/2 = 10 gms
15 gms x 2 lgs = 30 gms	10 gms x 9 lgs = 90 gms

Total League Games = 30 + 90 = 120

The 120 is under the 124 remaining games found in Step(6), so this division's determination is valid.

STEP(8): Before concluding that the leagues have been determined, a final check must be made on the approximations made in Step(1). Since the number of actual leagues determined (N=7, N=4, N=11) match the

numbers of leagues approximated, no further determinations need be made.

FINAL SOLUTION TO PROBLEM:

DIVISION N = 37 : 6-6-5-5-5-5-5 (2 lgs of 6, 5 lgs of 5)

DIVISION N = 24 : 6-6-6-6 (4 lgs of 6)

DIVISION N = 57 : 6-6-5-5-5-5-5-5-5-5-5 (2 lgs of 6, 9 lgs of 5)